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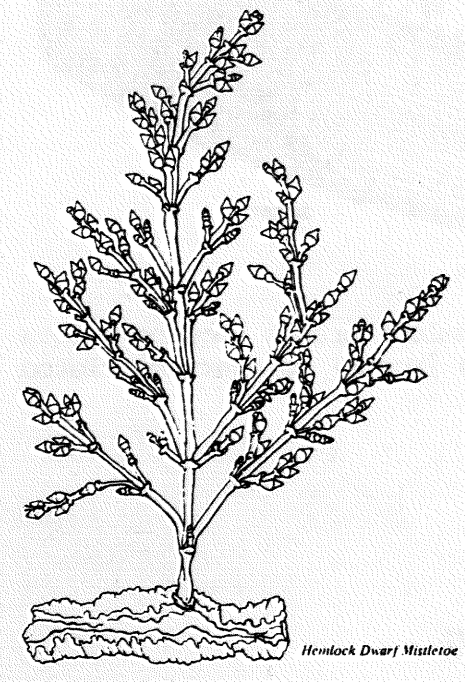
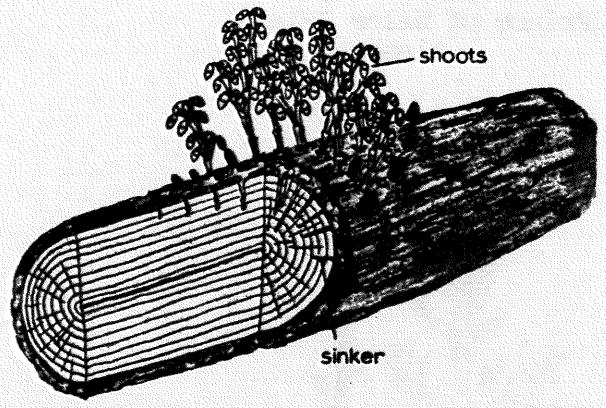
DWARF MISTLETOE DEMONSTRATION AREA

Thorne Bay
Prince of Wales Island
Alaska



Hemlock Dwarf Mistletoe



Infected hemlock branch showing shoots and sinkers (roots) of dwarf mistletoe

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Welcome to the Dwarf Mistletoe Demonstration Area. This guide will help you find your way on a walking tour to view dwarf mistletoe growing on hemlock trees. The tour begins 1.1 miles from the Thorne Bay Ranger Station (see map on back page). The demonstration area is intended to help forestry personnel and the general public to recognize dwarf mistletoe and become familiar with the biology, impact, and control options for hemlock dwarf mistletoe in young-growth forest stands in southeast Alaska.

Dwarf mistletoe is an important native disease of western hemlock in SE Alaska. This disease is caused by a small seed-bearing plant* that only survives as a parasite on live trees. It is a serious problem in old-growth forests where the disease often causes large clusters of branches, known as witches-brooms, on infected hemlocks. This parasite can reduce the height and diameter growth of hemlocks or even kill severely infected trees.

Clearcutting is a form of control, but live hemlocks infected with dwarf mistletoe are often left standing even after "clear" cutting. Spread of dwarf mistletoe from these trees may pose a threat to hemlocks in the young-growth stands.

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* The scientific name of hemlock dwarf mistletoe is Arceuthobium tsugense (Rosendahl) G.N. Jones

STOP 1

This young forest originated in 1962 after harvest of the old-growth western hemlock/Sitka spruce forest through clearcutting. The new stand was precommercially thinned in 1980 to a spacing of about 12 ft x 12 ft, leaving about 300 trees per acre.

Please follow the trail marked with stakes and pink flagging to tour the demonstration area. We suggest that you make the tour with a member of the USDA Forest Service staff. For safety reasons, this tour should be avoided on windy days. Please do not handle or remove mistletoe plants along this tour as this will alter the use of these plots for research purposes.

STOP 2

Researchers use these plots to follow the spread and intensification of hemlock dwarf mistletoe after thinning of the young stands that develop beneath infected residual trees, such as those 40 feet southwest and 100 feet northwest of the marker. These large trees were left at the time of old-growth harvest because they were considered nonmerchantable. Many of these residual hemlocks were severely infected with dwarf mistletoe, as shown by the large clusters of branches called witches-brooms. To control dwarf mistletoe, these trees were killed by girdling during the precommercial thinning. Girdles are clearly visible several feet above the ground on the residual trees.

STOP 3

Girdling generally kills residual trees within 3-5 years, but the effect on individual trees differs substantially. These differences can be seen in the standing dead and blown-down residuals that failed at the girdle.

The large witches' brooms indicate one or several infections 50 or more years ago by dwarf mistletoe.

Mistletoe seeds are produced on the short, yellow-green shoots of female plants five or more years after infection (see life cycle diagram). The seeds, which ripen in mid to late September, are coated with a water-soluable glue (viscin) that enables them to adhere to tree foliage and twigs after discharge.

Seeds ejected from plants high in a tree may travel up to 60 feet, but because 95% of them land within 30 feet of the infected residual we use a 30 ft radius for the study plots. The plots thus sample the most seriously affected areas in the stand; if litte damage from the parasite occurs here, we expect the stand as a whole to be affected even less.

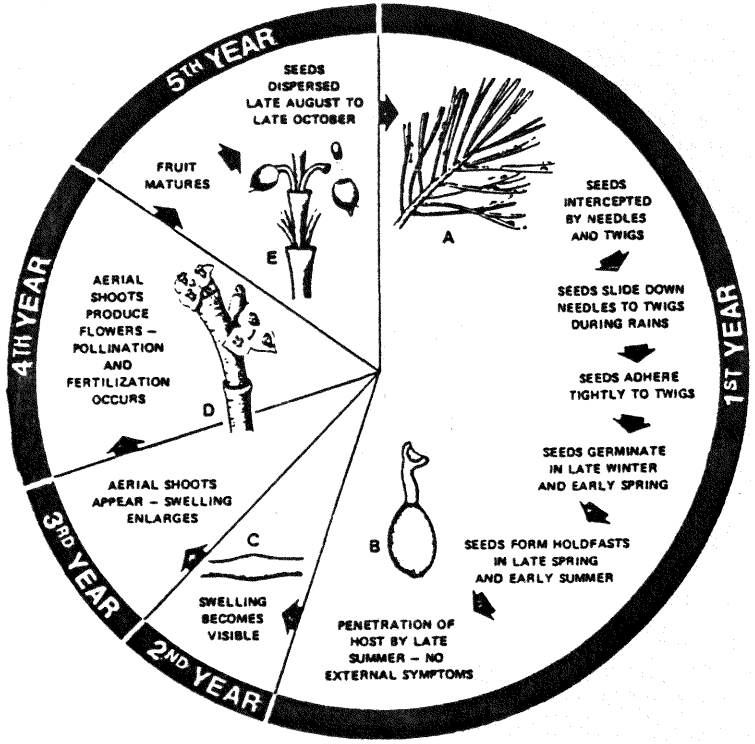
Note the small swelling (marked with blue flagging) on the young-growth hemlock about 8 ft behind the marker. The swelling is caused by dwarf mistletoe, but it has also been chewed by a rodent. Such chewing, which is not uncommon, is a form of biological activity that kills some infections--a means of natural control.

STOP 4

This site shows that proper management of young stands can keep hemlock dwarf mistletoe from developing into a serious disease problem. Silvicultural practices that help reduce problems with hemlock dwarf mistletoe are described at stop 5. Even though many heavily infected trees were left in this stand, few infections are present in the young, highly susceptible hemlock trees.

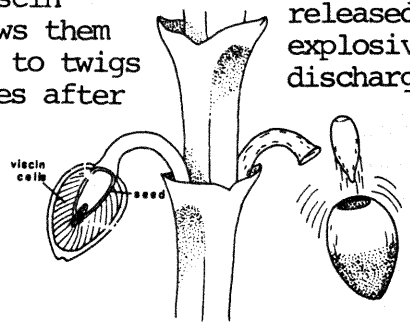
In these plots, all hemlock crop trees are evaluated every 2 years for dwarf mistletoe infections. Trees are climbed and each branch is examined for any evidence of dwarf mistletoe. The first symptom to appear after

Life Cycle of
Dwarf Mistletoe


5TH YEAR
1ST YEAR
2ND YEAR
3RD YEAR
4TH YEAR
SEEDS DISPERSED LATE AUGUST TO LATE OCTOBER
FRUIT MATURES
E
A
SEEDS INTERCEPTED BY NEEDLES AND TWIGS
SEEDS SLIDE DOWN NEEDLES TO TWIGS DURING RAINS
SEEDS ADHERE TIGHTLY TO TWIGS
SEEDS GERMINATE IN LATE WINTER AND EARLY SPRING
B
SEEDS FORM HOLDFASTS IN LATE SPRING AND EARLY SUMMER
PENETRATION OF HOST BY LATE SUMMER – NO EXTERNAL SYMPTOMS
SWELLING BECOMES VISIBLE
C
AERIAL SHOOTS APPEAR – SWELLING ENLARGES
AERIAL SHOOTS PRODUCE FLOWERS – POLLINATION AND FERTILIZATION OCCURS
D

Seeds are covered with a water-soluable glue called viscin that allows them to adhere to twigs and needles after discharge

Seeds are released by explosive discharge



infection is a slightly elongated swelling. One purpose of these plots is to determine the fate of such mistletoe infections. We want to know why some infections form witches-brooms and why some do not, and how long the witches-brooms take to develop.

The number of infections in trees here and elsewhere in SE Alaska is surprisingly low compared to similar stands in Oregon, Washington, and coastal British Columbia. For example, the 22 hemlock crop trees within 30 ft of the heavily infected residual tree (painted red) currently have a total of only 6 dwarf mistletoe infections, far too few to influence stand productivity.

STOP 5

Note the dwarf mistletoe infection in the lower crown of tree #70. Most infections are in the lower third of the live crown, which tends to limit the upward spread of dwarf mistletoe as the tree responds to thinning with rapid height growth. Branches in the lower crown die as the stand ages and the canopy closes, a process which kills the dwarf mistletoe infections on these lower branches. Also, the ability of these lower crown infections to spread dwarf mistletoe to nearby hemlock is hampered by the interspersion of highly resistant Sitka spruce, as seen on either side of this tree.

STOP 6

Note the dwarf mistletoe infections in this tree (#89). This hemlock, about 40 years old, was a small tree in the old-growth stand before harvest. In stands infested with dwarf mistletoe, such trees--called "advanced reproduction" are more commonly infected than trees that develop after harvest. The intensity of infection on advanced reproduction in infested stands is often higher than on this tree. Discrimination against such advanced

reproduction during thinning operations would be desirable.

STOP 7

The infection in the lower crown of tree #91 is likely to die because of self-pruning of this branch. Two infections in tree #89 at the previous stop are located higher in the crown, and thus are more likely to survive. If the plants are female, they could produce seeds and spread dwarf mistletoe to other trees.

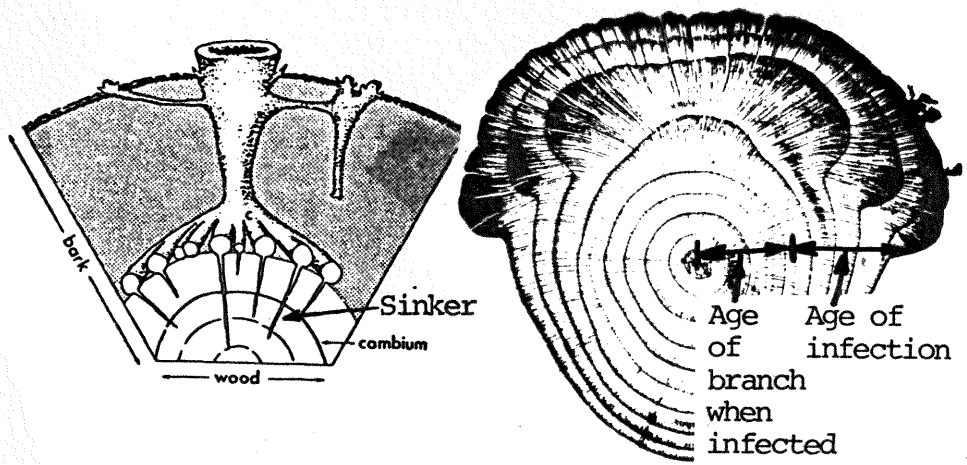
STOP 8

These hemlock trees are exceptions; they are heavily infected crop trees but not advanced reproduction. Note that most infections are confined to the lower crown where they will probably die through self-pruning of branches and are thus not likely to infect nearby hemlocks, particularly in their upper crowns. However, some of these infections may develop into large witches-brooms, which could reduce tree height and diameter growth.

Several infections marked with blue and white flagging may become main-stem infections if the mistletoe slowly progresses down the branch or the main stem grows out and engulfs the branch infection. Main-stem infections are rare on young trees, but serious because they may lower the quality and value of the log or reduce the tree's growth and vigor. Also, wood-decay fungi may enter the tree through these main-stem infections and cause further losses. Whether infected with wood-decay fungi or not, some trees tend to break at the location of mistletoe stem infections during high winds. Because such young hemlock trees with main-stem infections are scarce, however, their effect on stand growth is negligible.

The size of individual dwarf mistletoe infections often depends on branch size and the age of the infection. For example, some infections will die when the small lateral branches supporting them are shed during the process of natural pruning. Other infections will continue to develop and may eventually form witches-brooms.

Regardless of the size of an infection, the dwarf mistletoe roots, called "sinkers," grow into the hemlock tree (see diagram below). It is through these sinkers that the parasite obtains its nourishment, disrupts the tree's growth hormones, and interferes with the normal products of photosynthesis available for height and radial growth of the tree. The age of the infection and the age of the branch when it became infected can be determined by examining annual rings, as shown on the diagram. The initial year of infection is characterized by a swelling at the point of first contact by sinkers. Each year, sinkers grow outwardly, keeping pace with the tree's annual radial growth. Sinkers do not grow into wood that developed before infection.



STOP 9

Not all large swellings on residual hemlock trees are caused by dwarf mistletoe. This residual tree has several typical witches-brooms caused by dwarf mistletoe. The large, dark, spherical swellings visible throughout the crown were not caused by dwarf mistletoe, but by some unknown agent.

Look across the valley to the north, if the weather permits; you can see several dead, gray, residual trees that were girdled for mistletoe control during the 1980 thinning.

SUMMARY

Data collected to date in southeast Alaska, as you have seen along this tour, show that killing infected residual trees during precommercial thinning will prevent dwarf mistletoe from reaching damaging disease levels, even though stands may be somewhat infested. This conclusion is based on: the limited number of infections on crop trees remaining after thinning, the concentration of these infections in the lower crown branches, the height-growth response of the hemlock after thinning, and the interspersion of resistant Sitka spruce crop trees. Together, these factors limit the impact that the parasite should have within the planned 80- to 100-year rotation.

Visitors can now exit back through the plots and return to the road. Look for more dwarf mistletoe infections in young-growth hemlock trees, study the symptoms that dwarf mistletoe causes on hemlock trees, and observe the appearance of dwarf mistletoe plants. But please do not handle or remove mistletoe plants.

Establishing and maintaining these plots is a continuing, cooperative effort by:

Thorne Bay Ranger District
Ketchikan Area
Tongass National Forest
Forest Pest Management
State and Private Forestry
Region 10
Pacific NW Research Station
Forestry Sciences Laboratory
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